

CLAIMS

What is claimed is:

1 1. A method of molding composite structures
2 comprising:
3 providing a female mold defining the size and shape of
4 the outer surface of the composite structure being molded,
5 the female mold being openable and closable, and when closed,
6 having at least one vent adjacent the top of the mold cavity;
7 with the mold open, disposing reinforcing material and
8 an inflatable bladder in the mold, the reinforcing material
9 being disposed in an amount and location to provide the
10 desired reinforcement in the composite structure being
11 molded, the bladder being configured to be inflatable to
12 provide pressure on materials located between the bladder and
13 the mold;
14 closing the mold;
15 putting a resin into the mold;
16 pressurizing the bladder to a first pressure with an
17 incompressible fluid;
18 curing the resin;
19 depressurizing the bladder; and
20 opening the mold and removing the composite structure
21 from the mold and the bladder from the composite structure.

1 2. The method of claim 1 wherein the bladder is
2 depressurized and deflated.

1 3. The method off claim 1 wherein the resin is cured
2 using heat.

1 4. The method of claim 3 wherein the bladder is
2 inflated and pressurized to the first pressure using a heated
3 incompressible fluid.

1 5. The method of claim 4 wherein the incompressible
2 fluid is water.

1 6. The method of claim 1 wherein excess resin is
2 poured into the mold, and the excess resin is expelled
3 through the vent when the bladder is pressurized to the first
4 pressure.

1 7. The method of claim 6 wherein the excess resin is
2 recovered and used in a repeat of the method.

1 8. The method of claim 7 wherein the resin is cured
2 using heat.

1 9. The method of claim 8 wherein the excess resin is
2 recovered before being heated.

1 10. The method of claim 6 wherein the bladder is
2 inflated to a predetermined condition before the resin is put
3 in the mold.

1 11. The method of claim 10 wherein the predetermined
2 condition is a second pressure that is less than the first
3 pressure.

1 12. The method of claim 10 wherein the predetermined
2 condition is a predetermined volume of fluid in the bladder.

1 13. The method of claim 1 wherein the resin is cured
2 using RF energy.

1 14. The method of claim 1 wherein the reinforcing
2 comprises high strength filament.

1 15. The method of claim 1 wherein the reinforcing
2 comprises metal reinforcing.

1 16. The method of claim 1 wherein the reinforcing
2 comprises wood.

1 17. The method of claim 1 wherein the bladder is
2 deflated to a sub-atmospheric pressure before the mold is
3 opened.

1 18. The method of claim 1 wherein the bladder is
2 deflated to a sub-atmospheric pressure for removal from the
3 composite structure.

1 19. The method of claim 1 wherein the reinforcing
2 material is in the form of a mat or fabric.

1 20. The method of claim 19 wherein the mat or fabric
2 differs in characteristics across an area of the mat or
3 fabric in accordance with the variation in reinforcement
4 desired in the composite structure.

1 21. The method of claim 1 wherein a layer of gel coat
2 is sprayed onto the mold surfaces before disposing
3 of the reinforcing material and an inflatable bladder in the mold.

1 22. The method of claim 21 wherein the layer of gel
2 coat is sprayed onto the mold surfaces with the mold open.

1 23. The method of claim 1 wherein the bladder is a gum
2 rubber bladder.

1 24. The method of claim 1 wherein the composite
2 structure being molded is defined by only a part of the
3 internal surface of the female mold so as to not comprise a
4 hollow composite structure.

1 25. The method of claim 1 wherein the composite
2 structure being molded comprises a hollow composite
3 structure.

1 26. A method of molding elongate composite structures
2 having an internal cavity comprising:
3 providing a female mold defining the size and shape of
4 the outer surface of the composite structure being molded,
5 the female mold being openable and closable, and when closed,
6 having at least one vent adjacent the top of the mold cavity;
7 with the mold open, disposing reinforcing material and
8 an inflatable bladder in the mold, the bladder being in the
9 form of an elongate tube-like flexible member, the
10 reinforcing material being disposed around the bladder and in
11 an amount and location to provide the desired reinforcement
12 in the composite structure being molded, the bladder being
13 configured to be inflatable to provide pressure on materials
14 located between the bladder and the mold;
15 closing the mold;
16 pouring a resin into the mold;
17 inflating and pressurizing the bladder with an
18 incompressible fluid;
19 curing the resin;
20 depressurizing and deflating the bladder; and

21 opening the mold and removing the composite structure
22 from the mold and the bladder from the composite structure.

1 27. The method of claim 26 wherein the mold is
2 comprised of mold halves hinged together for opening an
3 closing.

1 28. The method of claim 27 wherein the bladder extends
2 through the length of the mold halves, and wherein the mold
3 is closed at the ends thereof by bulkheads, at least one open
4 end of the bladder being sealable within a respective
5 bulkhead with respect to a source of incompressible fluid.

1 29. The method of claim 26 wherein the bladder is
2 depressurized and deflated after depressurization.

1 30. The method of claim 26 wherein the resin is cured
2 using heat.

1 31. The method of claim 30 wherein the bladder is
2 inflated and pressurized to the first pressure using a heated
3 incompressible fluid.

1 32. The method of claim 31 wherein the incompressible
2 fluid is water.

1 33. The method of claim 26 wherein excess resin is
2 poured into the mold, and the excess resin is expelled

3 through the vent when the bladder is pressurized to the first
4 pressure.

1 34. The method of claim 33 wherein the excess resin is
2 recovered and used in a repeat of the method.

1 35. The method of claim 34 wherein the resin is cured
2 using heat.

1 36. The method of claim 35 wherein the excess resin is
2 recovered before being heated.

1 37. The method of claim 33 wherein the bladder is
2 inflated to a predetermined condition before the resin is put
3 in the mold.

1 38. The method of claim 37 wherein the predetermined
2 condition is a second pressure that is less than the first
3 pressure.

1 39. The method of claim 37 wherein the predetermined
2 condition is a predetermined volume of fluid in the bladder.

1 40. The method of claim 26 wherein the resin is cured
2 using RF energy.

1 41. The method of claim 26 wherein the reinforcing
2 comprises high strength filament.

1 42. The method of claim 26 wherein the reinforcing
2 comprises metal reinforcing.

1 43. The method of claim 26 wherein the reinforcing
2 comprises wood.

1 44. The method of claim 26 wherein the bladder is
2 deflated to a sub-atmospheric pressure before the mold is
3 opened.

1 45. The method of claim 26 wherein the bladder is
2 deflated to a sub-atmospheric pressure for removal from the
3 composite structure.

1 46. The method of claim 26 wherein the reinforcing
2 material is in the form of a mat or fabric.

1 47. The method of claim 46 wherein the mat or fabric
2 differs in characteristics across an area of the mat or
3 fabric in accordance with the variation in reinforcement
4 desired in the composite structure.

1 48. The method of claim 26 wherein a layer of gel coat
2 is sprayed onto the mold surfaces before disposing
3 reinforcing material and an inflatable bladder in the mold.

1 49. The method of claim 48 wherein the layer of gel
2 coat is sprayed onto the mold surfaces with the mold open.

1 50. The method of claim 26 wherein the bladder is a gum
2 rubber bladder.

1 51. The method of claim 26 wherein the composite
2 structure being molded is defined by only a part of the
3 internal surface of the female mold so as to not comprise a
4 hollow composite structure.

1 52. The method of claim 26 wherein the composite
2 structure being molded comprises a hollow composite
3 structure.

1 53. A method of molding utility poles comprising:
2 providing a female mold defining the size and shape of
3 the outer surface of the utility pole being molded, the
4 female mold comprising hinged mold halves openable and
5 closable, and when closed, having at least one vent adjacent
6 the top of the mold cavity;
7 with the mold open, disposing reinforcing material and
8 an inflatable bladder in the mold, the bladder being in the
9 form of an elongate tube-like flexible member, the
10 reinforcing material being disposed around the bladder and in
11 an amount and location to provide the desired reinforcement

12 in the utility pole being molded, the bladder being
13 configured to be inflatable to provide pressure on materials
14 located between the bladder and the mold;
15 closing the mold;
16 pouring a resin into the mold;
17 inflating and pressurizing the bladder with an
18 incompressible fluid;
19 curing the resin;
20 depressurizing and deflating the bladder; and
21 opening the mold and removing the utility pole from the
22 mold and the bladder from the utility pole.

1 54. The method of claim 53 wherein the bladder extends
2 through the length of the mold halves, and wherein the mold
3 is closed at ends thereof by bulkheads, at least one open end
4 of the bladder being sealable within a respective bulkhead
5 with respect to a source of incompressible fluid.

1 55. The method of claim 54 wherein the bladder is
2 depressurized and deflated after depressurization.

1 56. The method off claim 53 wherein the resin is cured
2 using heat.

1 57. The method of claim 56 wherein the bladder is
2 inflated and pressurized to the first pressure using a heated
3 incompressible fluid.

1 58. The method of claim 57 wherein the incompressible
2 fluid is water.

1 59. The method of claim 53 wherein excess resin is
2 poured into the mold, and the excess resin is expelled
3 through the vent when the bladder is pressurized to the first
4 pressure.

1 60. The method of claim 59 wherein the excess resin is
2 recovered and used in a repeat of the method.

1 61. The method of claim 60 wherein the resin is cured
2 using heat.

1 62. The method of claim 61 wherein the excess resin is
2 recovered before being heated.

1 63. The method of claim 59 wherein the bladder is
2 inflated to a predetermined condition before the resin is put
3 in the mold.

1 64. The method of claim 63 wherein the predetermined
2 condition is a second pressure that is less than the first
3 pressure.

1 65. The method of claim 63 wherein the predetermined
2 condition is a predetermined volume of fluid in the bladder.

1 66. The method of claim 53 wherein the resin is cured
2 using RF energy.

1 67. The method of claim 53 wherein the reinforcing
2 comprises high strength filament.

1 68. The method of claim 67 wherein the thickness of
2 reinforcing material disposed in the mold decreases from one
3 end of the mold to the other end of the mold.

1 69. The method of claim 68 wherein the mold defines a
2 mold cavity having a cross section which decreases between
3 first and second ends of the mold, and wherein the thickness
4 of the reinforcing material is greater adjacent the end of
5 the mold having the larger cross section.

1 70. The method of claim 67 wherein the mold defines a
2 mold cavity having a cross section which decreases between
3 first and second ends of the mold.

1 71. The method of claim 53 wherein the reinforcing
2 comprises metal reinforcing.

1 72. The method of claim 53 wherein the reinforcing
2 comprises wood.

1 73. The method of claim 53 wherein the bladder is
2 deflated to a sub-atmospheric pressure before the mold is
3 opened.

1 74. The method of claim 53 wherein the bladder is
2 deflated to a sub-atmospheric pressure for removal from the
3 utility pole.

1 75. The method of claim 53 wherein the reinforcing
2 material is in the form of a mat or fabric extending the
3 length of the mold and wrapping around the bladder for the
4 longitudinal edges of the mat or fabric overlap so that the
5 reinforcing material so that the longitudinal edges of the
6 mat or fabric overlap in the final utility pole.

1 76. The method of claim 75 wherein the mat or fabric
2 differs in characteristics across an area of the mat or
3 fabric in accordance with the variation in reinforcement
4 desired in the utility pole.

1 77. The method of claim 76 wherein the mat or fabric is
2 heavier per unit area adjacent a first end of the mold than
3 adjacent a second end of the mold.

1 78. The method of claim 77 wherein the cross sectional
2 area of the mold is larger adjacent the first end of the mold
3 than adjacent the second end of the mold.

1 79. The method of claim 78 wherein the cross sectional
2 area of the mold is tapered along the length of the mold
3 between the first end of the mold and the second end of the
4 mold.

1 80. The method of claim 53 wherein a layer of gel coat
2 is sprayed onto the mold surfaces before disposing
3 reinforcing material and an inflatable bladder in the mold.

1 81. The method of claim 80 wherein the layer of gel
2 coat is sprayed onto the mold surfaces with the mold open.

1 82. The method of claim 53 wherein the bladder is a gum
2 rubber bladder.